USSR / Radio Physics, Application of Radio-Physics Methods.   I-12

Abs Jour : Ref Zhur - Fizika No 3, 1957, No 7391

Abstract : natural frequency of the resonator, ω the frequency of the gene-
            rator, and H_{res} is the resonant frequency of the magnetic field.

Card   : 2/2   - 64 -

A. M. PROKHOROV: Coherent radiation of electrons in a synchrotron in the centimeter wave band

Abstract: An experimental investigation of the coherent radiation of electrons was made in a synchrotron with $E = 5 MeV$ energy and $R = ?$ cm orbital radius. The acceleration was by a high-frequency voltage with fr...... of electron rotation. The radiation at the 16-th and 2-... harmonics investigated, i.e., at $\lambda = 3$ cm and $\lambda = 2$ cm, respectiv...

The measured radiation power at these harmonics was ... which agrees well enough with the rated value. The initial and final size .... synchrotron was determined on the basis of the dependence of t... ...... radiation or the magnetic field magnitude ... ... wave values of ... ... which also agrees with rated values. (Nov. 1955)

PROKHOROV, A.M

Microwave rotation spectrum of the ethyl chloride, molecule. A. I. Barchukov, T. M. Minaeva, and A. M. Prokhorov. Soviet Phys., JETP 2, 760(1956)(English translation).—See C.A. 50, 10537f.

B. M. R.

PASOV, N.G.;   PROKHOROV, A.M.

Theory of the molecular generator and molecular power amplifier.
Zhur.eksp.i teor.fiz. 30 no.3:560-563 Mr '56.   (MLRA 9:8)

1. Fizicheskiy institut imeni P.N. Lebedeva Akademii nauk SSSR.
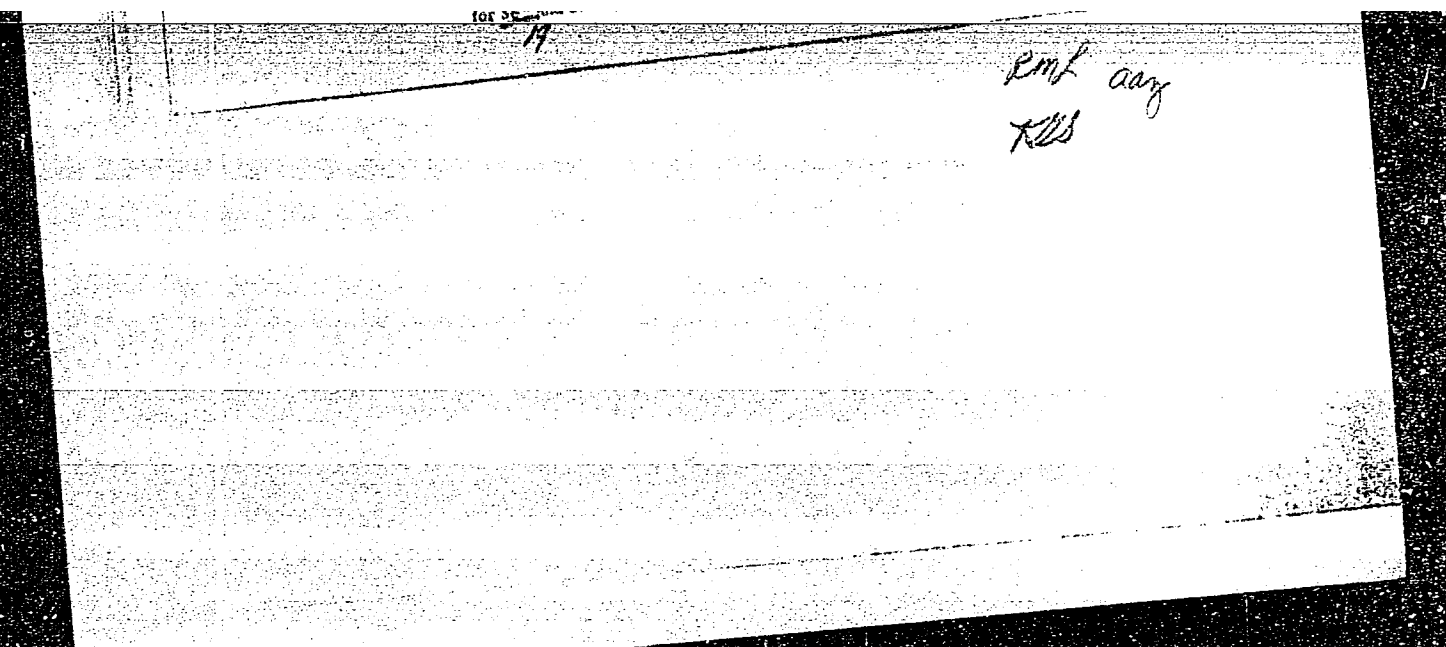(Molecular beams)
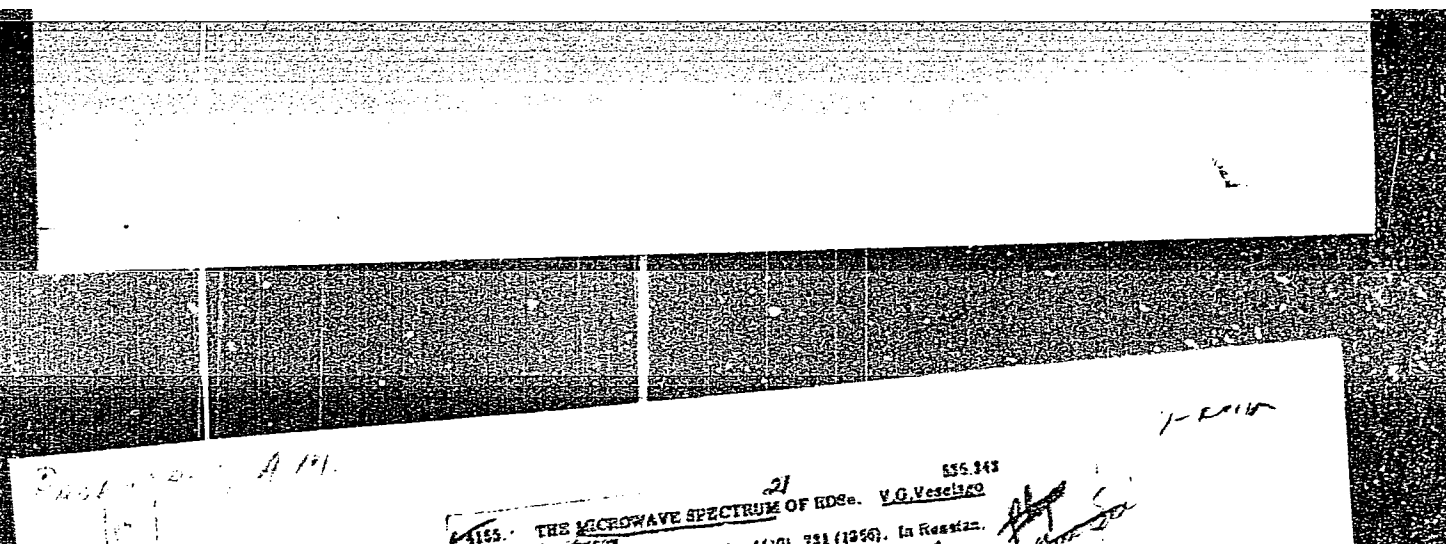
4155.   THE MICROWAVE SPECTRUM OF BDSe. V.G.Veselago

I-12

PROKHOROV, A. M.

Category : USSR/Radiophysics - Application of radiophysical methods

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 2044

Author   : Basov, N.G., Osipov, B.D., Prokhorov, A.M.
Title   : On a Molecular Generator without a Molecular Beam

Orig Pub : Uspekhi fiz. nauk, 1956, 59, No 2, 375

Abstract : Report that it is impossible to sort gas molecules using the method (See
           Ref. Zhur. Fiz, 1956, 20674) of static, electric, or magnetic fields.

Card   : 1/1

F-6

PROKHOROV, A.M.

Category : USSR/Magnetism - Magnetic radiospectroscopy

Abs Jour : Ref Zhur - Fizika, No 1, 1957 No 1467

Author : Manenkov, A.A., Prokhorov, A.M.
Inst : Physics Inst. Academy of Sciences USSR, Moscow
Title : Fine and Hyperfine Structure of Paramagnetic Resonance in Bivalent Europium

Orig Pub : Dokl. AN SSSR, 1956, 107, No 3, 402-404

Abstract : Paramagnetic resonance was investigated in the phospors SrS.Eu (powder) and CaF$_2$.Eu (monocrystal) at 9,341 Mc and at room temperature. The lines observed are due to transitions between magnetic levels of the E^{2+} ion in the $^8S_{7/2}$ state. An electron transition M = 1/2 ←→ -1/2, consisting of 12 hyperfine components due to the nuclear spins of the isotopes of Eu^{151} and Eu^{153} (I = 5/2), is observed in SrS.Eu. The following values of the constants are obtained: g = 1.992 ± 0.001; A$_{151}$ = (30.0 ±0.1) x 10^{-4}cm^{-1}; A$_{153}$ = (13.4 ±0.1) x 10^{-4} cm^{-1}; μ_{151}/μ_{153} = 2.24 ± 0.03 (A is the hyperfine coupling constant and μ the magnetic moment of the nucleus). Seven hyperfine-structure lines, each consisting of 12 hyperfine components, were observed in the monocrystal CaF$_2$.Eu. The g factor and A differ slightly from the values obtained in SrS.Eu, namely g = 1.971 ± 0.001, A$_{151}$ = (34.6± 0.1).10^{-4} and A$_{153}$ = (15.4 ± 0.1) x 10^{-4}cm^{-1}.

Card : 1/2

F-6

By measuring the distances between the extreme lines of the hyperfine structure for various electron transitions, it was possible to establish that the magnetic moments of U^{151} and U^{153} have the same sign.

Card   : 2/2

PROKHOROV, A.M.

PRIKHOT'KO, A F

24(7)   p 3   PHASE I BOOK EXPLOITATION   SOV/1365

L'vov. Universytet

Materialy X Vsesoyuznogo soveshchaniya po spektroskopii. t. 1:
Molekulyarnaya spektroskopiya (Papers of the 10th All-Union
Conference on Spectroscopy. Vol. 1: Molecular Spectroscopy)
[L'vov] Izd-vo L'vovskogo univ-ta, 1957. 499 p. 4,000 copies
printed. (Series: Its: Fizychnyy zbirnyk, vyp. 3/8/)

Additional Sponsoring Agency: Akademiya nauk SSSR. Komissiya po
spektroskopii. Ed.: Jazer, S.L.; Tech. Ed.: Saranyuk, T.V.;
Editorial Board: Landsberg, G.S., Academician (Resp. Ed., Deceased),
Neporent, B.S., Doctor of Physical and Mathematical Sciences,
Pabelinskiy, I.L., Doctor of Physical and Mathematical Sciences,
Fabrikant, V.A., Doctor of Physical and Mathematical Sciences,
Kornitskiy, V.G., Candidate of Technical Sciences, Rayskiy, S.M.,
Candidate of Physical and Mathematical Sciences, Klimovskiy, L.K.,
Candidate of Physical and Mathematical Sciences, Miliyanchuk, V.S.,
Candidate of Physical and Mathematical Sciences, and Glauberman,
A. Ye., Candidate of Physical and Mathematical Sciences.

Card 1/30

SOV/112-59-4-4570

8(6)

Translation from: Referativnyy zhurnal. Elektrotekhnika, 1959, Nr 4, p 26 (USSR)

AUTHOR: Prokhorov, A. M.

TITLE: Process Characteristics of Strong Basic Anionites

PERIODICAL: V sb.: Vnutrikotlovyye fiz.-khim. protsessy, vodopodgotovka i vodnyye rezhimy kotlov na elektrost. vysokikh i sverkhvysokikh parametrov. M., AS USSR, 1957, pp 515-531

ABSTRACT: Process characteristics of strong basic anionites are compared on the basis of a laboratory investigation. The silicon-consuming capacity of PEK, AV-16, and AV-17 anionites proved to be several times as high as that of EDE-10P anionite which is used at present. The PEK and AV-15 anionites are insufficiently stable. The silicon-consuming capacity of PEK materially drops after some time of its work; the AV-15 breaks into small particles in the course of work. The AV-16 and AV-17 anionites do not absorb O_2 from the water being filtered and, judging by their oxidability, do not enrich the filtrate

Card 1/2

SOV/113-57-4-4579

Process Characteristics of Strong Basic Anionites

with the products of their dissolving or disintegrating at temperatures under 40°C. A deep desilicification of water (down to a residual concentration of $SiO_3^{2-} \leqslant 0.1$ mg/liter) by the proven grades of anionites can be achieved with a sodium-hydroxide expenditure for regeneration exceeding the theoretically required quantity 8-10 times. By reusing alkaline waters, the reagent expenditure in the demineralizing plant can be reduced to 50 g per 1 gram-equivalent of the anions being removed (SO_4^{2-}, Cl^-, SiO_3^{2-}). As some impurities, such as carbon dioxide and various salts, affect the degree of water desilicification, it is necessary to remove all impurities from the water prior to the desilicification process.

N.P.S.

Card 2/2

PROKHOROV, A.M.

51-4-10/25

AUTHORS: Manenkov, A.A., Prokhorov, A.M., Trapeznikova, Z.A.
and Fok, M.V.

TITLE: Application of the paramagnetic resonance method to the study
of the activator state in phosphors. (Primeneniye metoda
paramagnitnogo rezonansa dlya issledovaniya sostoyaniya
aktivatora v fosforakh.)

PERIODICAL: "Optika i Spektroskopiya" (Optics and Spectroscopy),
1957, Vol.2, No.4, pp.470-474 (U.S.S.R.)

ABSTRACT: This paper was presented at the 5th Conference on
Luminescence in Tartu, June, 1956. From the nature (or
absence) of the paramagnetic resonance spectrum of a crystal
it is possible to deduce the valency state (and changes of
that valency state) of paramagnetic ions in crystal. This is
more difficult for powders when the paramagnetic absorption
lines may be very broad due to relaxation or anisotropy.
These difficulties are particularly pronounced for the case
of ions whose paramagnetism is due to unpaired d-electrons.
Measurements were carried
artificial CaF2:Eu ... crystal ...
out at 9340 Mc/s and at room temperature. The ... used
is described in Radiotekhnika i Elektronika, Vol.1, 469,
1956. Some of the present results were reported earlier
(A.A.Manenkov and A.M.Prokhorov, Doklady Akad. Nauk SSSR,

Card 1/3

51-4-10/25

Application of the paramagnetic resonance method to study of the activator state in phosphors. (Cont.)

Vol.107, 402, 1956). In SrS:Eu and CaF_2:Eu only the Eu^{2+} ion ($^8S_{7/2}$ state) is effective; Eu^{3+} is non-magnetic. For Eu^{2+} the electron spin is 7/2 and therefore 7 electron transitions are possible due to crystal electric field splitting. In SrS:Eu only one of these transitions $M = 1/2 \leftrightarrow -1/2$ was found; the others could not be observed due to anisotropic broadening. This one transition was split into 12 hyperfine structure (h.f.s.) components by the interaction of the nuclear spins of the two Eu isotopes: Eu^{151} and Eu^{153} with the electron Spim. The SrS:Eu paramagnetic spectrum confirms that the europium activator is in the Eu^{2+} state.   In the fluorite (CaF_2:Eu) spectrum all 7 electron transitions, each with 12 h.f.s. components, were observed. From the h.f.s. of the paramagnetic spectra of SrS:Eu and CaF_2:Eu the ratio of the magnetic moments of the Eu^{151} and Eu^{153} nuclei was found to be $\mu_{151}/\mu_{153} = +2.24 \pm 0.03$ nuclear magnetons. Frequency of the absorption lines for CaF_2:Eu monocrystals was found to depend strongly on the crystal orientation with respect to the applied constant magnetic field. This indicates that the crystal electric-field

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51-4-10/25

Application of the paramagnetic resonance method to study of the activator state in phosphors. (Cont.)

symmetry departs strongly from the cubic symmetry of the fluorite. In the SrS:Gd phosphor (powdered) only the line corresponding to the electron transition $M=1/2 \leftrightarrow -1/2$ was found. The gadolinium ion is Gd^{3+} in the $^8S_{1/2}$ state. Other electron transitions are not observed due to anisotropy broadening of lines. From a barely visible h.f.s. of the observed line it was estimated that magnetic moments of the Gd^{155} and Gd^{157} nuclei are of the order of 0.2 nuclear magnetons. Paramagnetic resonance study of the SrS:Eu:Sm phosphor excited with violet light indicated no ionization of the Eu^{2+} ion to Eu^{3+} due to excitation. This does not agree with optical studies by the authors which indicate 10% conversion of the Eu^{2+} to Eu^{3+} by ultraviolet light acting on SrS:Eu:Sm. Similar study of the SrS:Tb*Sm phosphors also failed to show any appreciable (more than 1%) ionization of the Tb^{3+} ion to Tb^{4+}. The authors thank V.V.Antonov-Romanovskii for criticism and P.P.Feofilov for supply of CaF_2:Eu crystals. There are 3 figures and 4 references, 2 of which are Slavic.

SUBMITTED: November 9, 1956.
AVAILABLE: Library of Congress
Card 3/3

PROKHOROV, A. M.

109-4-19/20

AUTHOR: Prokhorov, A.M.

TITLE: Influence of the Quality Factor of the Resonator on the Frequency of a Molecular Oscillator. (O vliyanii dobrotnosti rezonatora na chastotu molekulyarnogo generatora) (Letter to the Editor)

PERIODICAL: Radiotekhnika i Elektronika, 1957, Vol.2, No.4, p. 510 (USSR)

ABSTRACT: The oscillator was described by the author in an earlier work [Ref.1]. Here, it is pointed out that its frequency is also a function of the quality factor Q_p of the resonator; if Q_p changes by δQ_p the resulting relative change in frequency is:

$$\frac{\delta\omega}{\omega} = \frac{1}{\omega_0 \tau} \frac{\delta Q_p}{Q_p}$$

where ω_0 is the resonator frequency.

SUBMITTED: September 29, 1956.

AVAILABLE: Library of Congress.

Card 1/1

48-5-53/56

SUBJECT: USSR/Luminescence

AUTHORS: Manenkov A.A., Prokhorov A.M., Trapeznikova Z.A., and Fok M.V.

TITLE: Application of Paramagnetic Resonance Method for Investigation of the Activator State in Phosphors (Primeneniye metoda paramagnitnogo rezonansa dlya issledovaniya sostoyaniya aktivatora v fosforakh)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, 1957, Vol 21, #5, p 779 (USSR)

ABSTRACT: The paramagnetic resonance method was applied to determine the valence state of an activator in crystallophosphors and to detect the changes of valence during the excitation of phosphors.

The paramagnetic resonance was investigated in the phosphors SrS-Eu; CaF_2-Eu; SrS-Gd and SrS-Tb at the room temperature by means of a superheterodyne radiospectroscope. It was established that Eu in phosphors is in bivalent state (Eu^{2+}), and Gd and Tb are in the trivalent states (Gd^{3+} and Tb^{3+}). The ratio of nuclear magnetic momenta of Eu^{151} and Eu^{153} nuclei was determined to be 2.24 ± 0.03 by observing the

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48-5-53/56

TITLE: Application of Paramagnetic Resonance Method for Investigation of the Activator State in Phosphors (Primeneniye metoda para-magnitnogo rezonansa dlya issledovaniya sostoyaniya aktivatora v fosforakh)

superfine structure of Eu^{2+} and Gd^{3+} spectra. The values of nuclear magnetic momenta of Gd^{155} and Gd^{157} were estimated to be approximately equal to 0.2 of nuclear magnetons.

One Russian reference is cited.

INSTITUTION: Physical Institute im.Lebedev of the USSR Academy of Sciences.

PRESENTED BY:

SUBMITTED: No date indicated

AVAILABLE: At the Library of Congress.

Card 2/2

PROKHOROV, A.M.

GORBANEV, A.I.; KAYTMAZOV, S.D.; PROKHOROV, A.M.; TSENTSIPER. A.B.

The paramagnetic resonance of products formed at low temperatures
by the dissociation in the glow discharge of H2O, H2O2 and D2O vapors.
Zhur.fiz.khim. 31 no.2:515 F '57.
(MIRA 10:9)

1. AN SSSR Institut obshchey i neorganicheskoy khimii im. N.S...urnakova
i Fizicheskii institut im. P.N.Lebedeva.
(Low temperature research) (Hydrogen peroxide) (Water)

PROKHOROV, A.M.

56-3-44/59

AUTHORS: Korniyenko, L.S., Prokhorov, A.M.

TITLE: The Fine Structure of the Spectrum of the Paramagnetic Electron Resonance of the Fe3+ Ions in the Lattice of Al_2O_3 (Ton'kaya struktura spektra elektronnogo paramagnitnogo rezonansa ionov Fe3+ v reshetke Al_2O_3) (Letter to the Editor)

ABSTRACT: The Fe^{3+} ions were introduced isomorphically into the Al_2O_3-lattice. The spectrum mentioned in the title was investigated at room temperature, at 3 frequencies of $2,5 \cdot 10^{10} - 4 \cdot 10^{10}$ at field strengths of up to 16.200 Örsted. The following results were obtained: The Fe^{3+} ions form 2 systems of not equivalent ions and each of these systems furnishes a spectrum consisting of 5 resonance lines. If the outer magnetic field is applied parallel or vertical to the axis of the crystal, both spectra blend. This tends to confirm the existence of a similar direction of the axial crystal field for both ion systems. If the direction of the outer magnetic field deviates strongly from the parallel or vertical direction, the lines of both

Card 1/2

The Fine Structure of the Spectrum of the Paramagnetic Electron Resonance
of the Fe^{3+} Ions in the Lattice of Al_2O_3

... stronger and show a weak shift in each ... ... to confirm the fact that in each ... ... two subsystems with several different ... rent directions of the axes of the cubic crystal lattice exist. A Hamiltonian for the interpretation of this spectrum is written down. The formulae given here at certain numerical values of the constants agree well with experimental data. Also the spectrum of a sample enriched with the isotope Fe^{57} was investigated and no fine structure of the lines was observed. This confirms the opinions concerning the smallness of the magnetic moment of the nucleus of the iron isotope mentioned. There is 1 reference.

ASSOCIATION: Moscow State University
               (Moskovskiy gosudarstvennyy universitet)

SUBMITTED: June 16, 1957

AVAILABLE: Library of Congress

Card 2/2

PROKHOROV, A. M.

56-5-5/46

AUTHORS: Manenkov, A. A., Prokhorov, A. M.

TITLE: A Determination of the Nuclear Moments of Gd155 and Gd157 From the Hyperfine Structure of Paramagnetic Resonance (Opredeleniye yadernykh momentov Gd155 i Gd157 iz sverkhtonkoy struktury paramagnitnogo rezonansa)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1957 Vol. 33, Nr 5, pp. 1116-1118 (USSR)

ABSTRACT: The gadolinium spectrum was recorded by means of a superheterodyne radiospectroscope at 9383 MHz. The magnetic field was measured by means of the proton resonance. A SrS-Gd preparation was used for measuring the paramagnetic resonance, in which case Gd155 or Gd157 respectively, were found accumulated in enriched state ($\sim$93%) in the test pieces.
The following results were obtained:
    I = 3/2 for Gd155 and Gd157

$$\left|\mu(Gd^{155})\right| : \left|\mu(Gd^{157})\right| = 0,73 \pm 0,03$$

From a comparison of the decomposition of the hyperfine structure of SrS - Gd3+ and SrS - Eu2+ results:

$$\left|\mu(Eu^{151})\right| : \left|\mu(Gd^{157})\right| = 10,60 \pm 0,03$$

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A Determination of the Nuclear Moments of Gd^{155} and Gd^{157} From   56-5-5/46
the Hyperfine Structure of Paramagnetic Resonance.

Let it be assumed that 3,6 is the (theoretical value) of $\mu(Eu^{151})$, it hence results from the ratio measured:

$$\left|\mu(Gd^{155})\right| = 0,25 \text{ atomic magnetons}$$

$$\left|\mu(Gd^{157})\right| = 0,34 \text{ atomic magnetons}$$

There are 1 table, 1 figure, and 11 references, 3 of which are Slavic.

ASSOCIATION: Physics Institute imeni P. N. Lebedev of AN USSR (Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR)

SUBMITTED: May 11, 1957

AVAILABLE: Library of Congress

Card 2/2

PROKHOROV, A.M.

56-6-16/47

AUTHORS: Kontorovich, V. M. , Prokhorov, A. M.

TITLE: On the Nonlinear Effects of the Interaction of the Resonance Fields in a Molecular Generator and   Amplifier (O nelineynykh effektakh vzaimodeystviya rezonansnykh poley v molekulyarnom generatore i usilitele)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1957, Vol. 33, Nr 6 (12), pp. 1428 - 1430 (USSR)

ABSTRACT: On the basis of the analysis of the polarizability of a quantum--like system (which is at the same time in 2 resonance fields) the position of the possible frequencies of production and amplification is investigated by the present paper by taking account of saturation with respect to an auxiliary field. May this quantum system be assumed to have a non-equidistant discrete spectrum. The frequencies ω_1 and ω_2 are near the frequencies ω_{mn} and ω_{mq} of the transitions between any 2 levels of the system, if one of these 2 resonance levels is common to both fields. Just these levels are here described as resonance levels. At first an expression for the Fourier components of the average dipole moment in the here investigated case of a gas is given. For the molecules of this gas

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56-6-16/47

On the Nonlinear Effects of the Interaction of the Resonance Fields in a Molecular Generator and Amplifier

the average time between 2 collisions is $\mathcal{T}$. The disturbed Hamiltonian is $\hat{H}(t) = \hat{H}_o + h\hat{V}(t)$ with $\hat{V}(t) = \hat{\Phi} \pm e^{\pm i\omega_4 t} + \hat{\psi} \pm e^{\pm i\omega_2 t}$, and $\pm$ summation must be carried out. An equation for the determination of the resonance portion of the density matrix $\hat{D}$, an ansatz for the solution of this equation, and an expression for the resonance part of the dipole moments of the system are then given. The curve of absorption in general has 2 maxima. The relations for the determination of the position of these 2 maxima are also given. In the case under investigation the absorption curve has 2 approximately equal maxima. In general, the real part of polarizability becomes equal to zero at 3 points. The formulae obtained lead to the following conclusions concerning a molecular generator and amplifier when using auxiliary radiation: 1.) In the case of strong auxiliary radiation, the amplifier is able to work on 2 frequencies. 2.) The molecular generator is excited on those frequencies for which the real part of polarizability is equal to or nearly equal to zero. Consequently, oscillations in the generator type under investigation can occur on 3 frequencies, in which case the middle frequency is nonstable. The frequencies of the oscillations of the generator will depend on the frequency and also on the amplitude

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56-6-16/47

On the Nonlinear Effects of the Interaction of the Resonance Fields in a Molecular Generator and Amplifier

        of the auxiliary field. There are 3 references, 1 of which is Slavic.

ASSOCIATION: Institute of. Radiophysics and Electronics AN Ukrainian SSR
               (Institut radiofiziki i elektroniki Akademii nauk Ukrainskoy SSR)
               Institute of Physics imeni P.N. Lebedev AN USSR
               (Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR)

SUBMITTED: June 7, 1957

AVAILABLE: Library of Congress

Card 3/3

PROKHOROV, A.M.

AUTHOR: MANENKOV,A.A., PROKHOROV,A,M., TRUKHLYAYEV,P.S.   PA - 2239
            YAKOVLEV,G.N.

TITLE: The Hyperfine Structure of Paramagnetic Resonance. The Nuclear
            Spin and Magnetic Moment of 5,3 radioactive isotope of Eu^{152}.
            (Sverkhton'kaya struktura paramagnetnogo rezonansa. Yadernyy
            spin i magnitnyy moment 5,3 - godichnogo radioaktivnogo izotopa
            Eu^{152}.Russian)

ABSTRACT: The present work investigates paramagnetic resonance in powdery
            phosphorus SrS, which was activated with europium containing
            5,3 isotope Eu^{152}. Eu^{152} was produced by irradiation of the natu-
            ral europium isotope Eu^{151} and Eu^{153} with reactor neutrons. On
            the occasion of this irradiation a mixture of the isotopes
            Eu^{151}, Eu^{152}, and Eu^{153} (relative quota 19%, 17%, and 54%) was
            obtained. Next, the production of the phosphorus SrS activated
            by means of this isotope admixture is discussed. The concentration
            of the europium in phosphorus amounted to ~10^{-4}.

            Paramagnetic resonance in this phosphorus sample was investigated
            on the frequency of 9343 Ke by means of a superheterodyne radio-
Card 1/3   spectros-cope. The thus observed spectrum is shown in a drawing;

PA - 2239

The Hyperfine Structure of Paramagnetic Resonance. The Nuclear Spin and Magnetic Moment of 5,3 Radioactive Isotope of Eu^{152}.

it consists of three series of hyperfine structure components which are caused by the nuclei of Eu^{151}, Eu^{152}, and Eu^{153}. The spectrum corresponds to the only electron transition $M = 1/2 \quad -1/2$. Series I consists of the most intense lines caused by Eu^{153}, the less intense series belongs to Eu^{151}, and the least intense series III belongs to the radioactive isotope Eu^{152}. The magnetic field was measured by means of proton resonance.

The series I and II each have 6 components which corresponds to the nuclear spins $I = 5/2$ of Eu^{151} and Eu^{152} and the total separations in these series furnish the value $\mu_{151}/\mu_{153} = 2,24$ for the ratio of the magnetic moments of the nuclei of Eu^{151} and Eu^{153}. As a result of overlapping with the lines of Eu^{151} not all components were dissolved in the series. Fully dissolved were the lines 14,225; 14,160; 14,290, and 14,416 kc. The relative distances between these lines indicate the nuclear spin $I = 3$ of the Eu^{152}. Some more arguments in favor of the value $I = 3$ are given. Next, a formula for the frequencies of the observed spectrum is written down. Comparison of the observed frequencies with this formula

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PA - 2239

The Hyperfine Structure of Paramagnetic resonance. The Nuclear Spin and Magnetic Moment of 5,3 Radioactive Isotope of Eu^{152}.

furnishes the values $g = 1,992 \pm 0,001$; $A_{152} = 0,064 \pm 0,002$ kc (according to the frequency scale of proton resonance); $A_{152} =$ $= (13,9 \pm 0,1).10^{-4} cm^{-1}$ for the g-factor and for the hyperfine structure constant A_{152}. Total hyperfine separation is proportional to the magnetic moment. Among others $\mu_{152} = 2,03$ nuclear magnetons are found.

ASSOCIATION: Not given
PRESENTED BY: Member of the Academy ARTSIMOVICH,L.A., on 13.11.1956
SUBMITTED: 2.11.1956
AVAILABLE: Library of Congress

Card 3/3

KAYTMAZOV, S. D., PROKHOROV, A. M. and TSENTSIPER, A. B.

"Electron Paramagnetic Resonance of Radicals Obtained From H_2O and H_2O_2" p.23

Trudy Transactions of the First Conference on Radioaction Chemistry, Moscow,
Izd-vo AN SSSR, 1958. 330pp.
Conference -25-30 March 1957, Moscow

BASOV, N.G.;MURIN, I.D.; PETROV, A.P.; PROKHOROV, A.M.; SHTRANIKH, I.V.

Molecular clock. Izv.vys.ucheb.zav.: radiofiz. 1 no.3:50-53 '58.
(MIRA 12:1)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR.
(Time measurements) (Molecules--Vibration)

SOV/109-3-11-10/13

AUTHORS: Murina, T.M., Prokhorov, A.M. and Chayanova, E.A.

TITLE: Measurement of the Absolute Intensity of the Absorption
Lines (Izmereniye absolyutnykh intensivnostey liniy
pogloshcheniya) (Letter to the Editor)

PERIODICAL: Radiotekhnika i Elektronika, 1958, Vol 3, Nr 11,
pp 1402 - 1404 (USSR)

ABSTRACT: It is shown that the measurement of the absolute
intensity of the absorption lines can be done by means of
a ferrite modulator such as shown in Figure 1. This
consists of (1, 2) sections of a rectangular waveguide,
(3) a circular waveguide, (4) a magnetising solenoid,
(5) sample of ferrite and (6) a dielectric holder. The
modulator is based on the Faraday effect and permits
the modulation of transmitted power at the frequency of
the Stark modulation. For the measurements, the
modulator is placed between a klystron and an absorbing
cell, the modulation frequency being 75 kc/s. It is
shown that, if the detector (at the output of the
waveguide (2) in Figure 1) has a square characteristic,
the ratio of the low-frequency component of the output
voltage to the direct-current component is equal to twice
the modulation index. A curve of the voltage ratio as

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Measurement of the Absolute Intensity of the Absorption Lines   SOV/109-3-11-10/13

a function of the detector current is shown in Figure 2.
From this, it is seen that the detector has a square
characteristic from 0 to 0.4 mA. The method was used to
determine the absolute intensity of the ammonia absorption
lines. It was found that the error was of the order of
3.5%. There are 2 figures and 2 Soviet references.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR
               (Institute of Physics imeni P.N. Lebedev of
               the Ac.Sc.USSR)

SUBMITTED: February 22, 1958

Card 2/2

Sov/51-4-4-14/24

AUTHORS: Barchukov, A.I., Murina, T.M. and Prokhorov, A.M.

TITLE: Microwave Spectrum and Rotational Constants of the C_2H_5Cl
           Molecule (Mikrovolnovyy spektr i vrashchatel'nyye postoya-
           nnye molekuly C_2H_5Cl)

ABSTRACT: Microwave rotational spectrum of ethyl chloride
              (C_2H_5Cl) was first described in 1954 (Reference1). An approx-
              imate value of the rotational constant A for the $C_2H_5Cl^{35}$
              molecule and the value of the dipole moment μ_a were given
              in Ref 2. The present paper reports a more precise deter-
              mination of A from transitions related to changes of the
              dipole moment μ_b. For this purpose, the transitions
              $0_{00} \to 1_{11} (\nu = A + C)$ and $1_{01} \to 1_{10} (\nu = A - C)$ were found to
              be most convenient. The first of these transitions lies in
              the region of 36 000 Mc/s and the second in the 26 000 Mc/s
              region. The ethyl chloride spectrum was found to be very rich
              in lines in the range from 25 000 to 42 000 Mc/s. The lines of

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Sov/51-4-4-14/24

Microwave Spectrum and Rotational Constants of the C_2H_5Cl Molecule

the Q-branch from $I = 1$ to $I = 9$ lie in this range. The Q-branch was identified graphically by a method described in the present note. The value of A for the $C_2H_5Cl^{35}$ molecule obtained from the transition $1_{01} \rightarrow 1_{10}$ is $31\ 337.6 \pm 0.5$ Mc/s and the value of A obtained from the $0_{00} \rightarrow 1_{11}$ transition is $31\ 336.4$ Mc/s. Since the hyperfine structure of the $0_{00} \rightarrow 1_{11}$ transition was not fully resolved, the value of A obtained from the $1_{01} \rightarrow 1_{10}$ transition is the more reliable. From the transitions considered here the value of the rotational constant C was found to be $4\ 961.6$ Mc/s, which agrees with the value reported in Ref 1. The rotational constant A for the $C_2H_5Cl^{37}$ was found to be $31\ 285.7$ Mc/s. Table 1 on p 522 gives the frequencies of the $1_{01} \rightarrow 1_{10}$ transition lines for various values of F. Table 2 gives the calculated (second column) and experimental (third column) values of rotational constants A, B and C for the $C_2H_5Cl^{35}$ and

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Microwave Spectrum and Rotational Constants of the C_2H_5Cl Molecule

$C_2H_5Cl^{37}$ molecules. Table 2 shows good agreement between the experimental and calculated values. The value of the dipole moment μ_a was found from the Stark splitting of the $0_{00} \rightarrow 1_{01}$ transition. This value is given as 1.745 D $\pm$ 1.2% . There are 1 figure, 2 tables and 3 references, 1 of which is Soviet and 2 are in English.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR
(Physics Institute imeni P.N. Lebedev, Ac.Sc. USSR)

SUBMITTED: April 4, 1957

Card 3/3   1. Ethyl chlorides--Spectrographic analysis

SOV/51-5-5-6/23

AUTHORS: Barchukov, A.I. and Prokhorov, A.M.

TITLE: The Quadruple Coupling Dipole Moment and Barrier to Internal
            Rotation in the CH_3GeH_3 Molecule Obtained from its Rotational Spectrum
            (Kvadrupol'naya svyaz', dipol'nyy moment i bar'yer vnutrennego
            vrashcheniya v molekule CH_3GeH_3 iz yeye vrashchatel'nogo spektra)

PERIODICAL: Optika i Spektroskopiya, 1958, Vol 5, Nr 5, pp 530-534 (USSR)

ABSTRACT: CH_3GeH_3 was prepared by Vzenkova by the method described in Ref 2.
            This compound is a colourless liquid boiling at $-23^\circ C$. It does not
            react with the material of the absorption cell. The rotational spectrum
            of CH_3GeH_3 was studied using a radiospectroscope with 100 kc/s
            Stark-modulation. Transitions $J = 0 \to 1$ ($\lambda \sim 1.7$ cm), $J = 1 \to 2$ ($\lambda \sim 8.9$ mm)
            were studied in an absorption cell 4 m long and 6 x 12 mm in cross-
            section. The $J = 3 \to 4$ transition ($\lambda \sim 4.4$ mm) was studied using a
            radiospectroscope for millimetre wavelengths (Ref 3) in an absorption
            cell 50 cm long and 3.6 x 7.2 mm in cross-section. The spectrum was
            obtained at the temperature of dry ice. The lines of $C^{12}H_3GeH_3$ were
            observed on an oscillograph screen. The $C^{13}H_3GeH_3$ spectrum was
            observed using a synchronous detector and an electronic potentiometer
            EPP-09. The frequencies were measured using a quartz standard and an

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SOV/51-5-5-6/23

The Quadruple Coupling Dipole Moment and Barrier to Internal Rotation in the
CH_3GeH_3 Molecule Obtained From its Rotational Spectrum

auxiliary generator which was working at a frequency much higher than the quartz standard. The quartz standard was checked using standard frequency transmissions by radio. Table 1 gives the experimental frequencies of the observed lines (in Mc/s). Table 2 gives the values of the rotational constant B (in Mc/s) and the moments of inertia I_B (in atomic units x $Å^2$) for various isotopic combinations of CH_3GeH_3. From the experimental results reported here only the C--Ge separation can be calculated exactly. Its value is 1.946 Å. To determine other bond lengths and angles it is necessary to replace partially hydrogen by deuterium in CH_3GeH_3. The authors found that, if the structural parameters of CH_3SiH_3 (given in Ref 6) are used to calculate the rotational constants of CH_3GeH_3, then the values calculated in this way differ only by 5 Mc/s from those reported in the present paper.

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The Quadruple Coupling Dipole Moment and Barrier to Internal Rotation in the CH_3GeH_3 Molecule Obtained From its Rotational Spectrum

The dipole moment of CH_3GeH_3 was calculated and found to be 0.67 Debye units. The nuclear quadruple coupling for $C^{12}H_3Ge^{73}H_3$ is less than 1 Mc/s. The smallness of this value is due to the covalent nature of the C--Ge bond. The potential barrier to internal rotation in CH_3GeH_3 is 580 cm^{-1}. There is 1 figure, 2 tables and 7 references, 4 of which are American and 3 Soviet.

SUBMITTED: December 21, 1957

Card 3/3

1. Molecules--Dipole moments   2. Molecules--Testing equipment
3. Molecular rotation--Spectrum

SOV/51-4-6-16/24

AUTHORS: Barchukov, A.I. and Prokhorov, A.M.

TITLE: Microwave Spectrum of the CH_3GeH_3 Molecule (Mikrovolnovyy spektr molekuly CH_3GeH_3)

ABSTRACT: A complete translation. Spectrum of various isotopic combinations of the molecule CH_3GeH_3 were studied in the region of 33000-35000 Mc/s. The authors studied the transition $J = 1 \rightarrow 2$ which lies in this frequency region. The studied molecule exhibits internal rotation of the CH_3 and GeH_3 groups with respect to one another. The lines which were due to torsional vibrations were observed. These lines were four times weaker than the lines of the ground state ($v = 0$) and were separated by about 80 Mc/s from the latter. The excited-state line ($v = 1$) was split into two components with a ratio of intensities of 1 : 2 and a separation of 1.8 Mc/s between them.

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SOV/51-4-6-16/24

Microwave Spectrum of the CH_3GeH_3 Molecule

Molecule	B (v = 0)	B (v = 1)
$C^{12}H_3Ge^{76}H_3$	8621.1 ± 0.2	8.600
$C^{12}H_3Ge^{74}H_3$	8649.5 ± 0.2	8.628
$C^{12}H_3Ge^{73}H_3$	8663.9 ± 0.3	8.643
$C^{12}H_3Ge^{72}H_3$	8678.9 ± 0.2	8.659
$C^{12}H_3Ge^{70}H_3$	8710.2 ± 0.2	8.689
$C^{13}H_3Ge^{74}H_3$	8275.2 ± 0.2	—
$C^{13}H_3Ge^{72}H_3$	8305.2 ± 0.2	—
$C^{13}H_3Ge^{70}H_3$	8337.2 ± 0.3	—

The table given above contains values of the rotational constants B
for various isotopic combinations of the ground (v = 0) and
excited (v = 1) states. Observation of lines of various isotopic
combinations made it possible to determine the distance C--Ge which
was found to be equal to 1.946 ± 0.001 Å. From the study of the

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3

Microwave Spectrum of the CH_3GeH_3 Molecule

Stark effect of the $C^{12}H_3Ge^{74}H_3$ line the value of the dipole moment of molecules was found to be $\mu = 0.67 \pm 1.5\%$ debyes. Measurement of the relative intensities of the lines of the ground (v = 0) and the first excited (v = 1) torsional states yielded value of the frequency of torsional vibrations, $v = 195$ cm^{-1}. Assuming that the potential barrier is of cosine form, the barrier height was found to be $V_0 = 585$ cm^{-1}. Spectrum of the studied molecule was measured using a radio-spectroscope with Stark-modulation. The line frequencies were measured with a quartz generator. CH_3GeH_3 was prepared in the Physical Institute imeni P.N. Lebedev of the Academy of Sciences of the U.S.S.R. by G. Ya. Vzenkova by the method developed by V.A. Ponomarenko and G. Ya. Vzenkova (Ref 1), and the present authors thank the latter two people for their help.

Card 3/4 *Physics Inst. im P.N Lebecev
3
Ac. Sc. USSR*

Prokhorov A. M.

56-2-37/51

AUTHORS: Zverev, G. M. , Prokhorov, A. M.

TITLE: **The Fine and Hyperfine Structure of the**
Spectrum of Paramagnetic Resonance of Cr^{3+} in Corundum
(Tonkaya i syerkhtonkaya struktura spektra paramagnitnogo
rezonansa Cr^{3+} v korunde)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1958,
Vol 34, Nr 2, pp 513 - 514 (USSR)

ABSTRACT: First three works dealing with the same subject are mentioned.
The authors investigated in detail this spectrum at a fre-
quency of 37860 megacycles. The behavior of the energy levels
with an external magnetic field being present is described
by an Hamiltonian mentioned here. The microstructure was in-
vestigated of a corundum monocrystal which contained chromium
in 1000-fold dilution. The position of the lines was measured
for two orientations of the crystal in the external magnetic
field: 1) The trigonal axis $Z \parallel H$; 2) the trigonal axis

Card 1/3 $Z \perp H$. In the first mentioned case three absorption lines were

The **Fine and Hyperfine Structure of the Spectrum of Para-**
magnetic Resonance of Cr^{3+} in Corundum

56-2-37/51

noticed which correspond to the transitions between the levels
with the following values for M_z: 1) $-3/2 \leftrightarrow -1/2$; 2) $-1/2 \leftrightarrow$
$\leftrightarrow +1/2$; 3) $+1/2 \leftrightarrow +3/2$. In the second case the energy states
ε_1, ε_2, ε_3, ε_4 form a mixture of states of various M_z. Al-
together 6 absorption lines were observed of which the first
three have an intensity which is smaller by two orders of
magnitude than the last three. From the position of these
lines the values of the constants in the spin Hamiltonian
were determined. Proceeding from these values the position
of all lines was computed. The experimental values coincide
well with those computed. The spin-lattice relaxation time
T_1 obviously has the order of magnitude 10^{-2} sec. The hyper-
-microstructure was investigated by means of a sample contain-
ing chromium in form of 95 % Cr^{95}; the dilution was 1 : 10000.
The hyper-microstructre is only well dissolved in the case
of the line $-1/2 \leftrightarrow + 1/2$ with parallel orientation and in
that of the line $\varepsilon_2 \leftrightarrow \varepsilon_3$ with vertical orientation. There
are 4 components which correspond to the various projections
of the nuclear spin $(I = 3/2)$. The components do not have

Card 2/3   the same distance: The distance between the two inner

The **Fine and Hyperfine Structure of the Spectrum of Para-**
magnetic Resonance of Cr^{3+} in Corundum

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? Para-

lines is less than one third of that of the outer lines.
These irregular distances can be explained by the existence
of a weak line in the center (which corresponds to the even
isotopes in the sample). The following values were found
for the hyper-microstructure constants A and B; $|A| = (16,8 \pm 0,04).10^{-4}$ cm^{-1} and $|B| = (16,8 \pm 0,06).10^{-4}$ cm^{-1}. The
coincidence of these values speaks in favor of the practi-
cally complete isotropy of the hyper-microstructure. There
are 1 figure, and 4 references, 3 of which are Slavic.

ASSOCIATION: **Moscow State University**
(Moskovskiy gosudarstvennyy universitet)

SUBMITTED: November 13, 1957

AVAILABLE: Library of Congress

Card 3/3

1. **Paramagnetic resonance-Spectrum analysis**

AUTHORS: Pashinin, P. P. , Prokhorov, A. M.   SOV/56-34-3-52/55

TITLE: The Measurement of the Spin-Lattice Relaxation-Time of Cr^{+++} in Corundum (Izmereniye vremeni spin-reshetochnoy relaksatsii Cr^{+++} v korunde)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1958, Vol. 34, Nr 3, pp. 777 - 777 (USSR)

ABSTRACT: The knowledge of the times of the spin-lattice-relaxation in paramagnetic compounds is of special interest in connection with the elaborate investigations carried out recently with respect to the manufacture of molecular amplifiers with little noise, based upon paramagnetic substances. The authors determined the time of the spin-lattice-relaxation for the ion Cr^{+++} in the lattice of the corundum A$_2$O$_3$-Cr$_2$O$_3$ for the electron transition 3/2 → 1/2. The measurements were carried out on the frequency of 9370 megacycles at the temperatures of T = 300°K and T = 77°K by observation of the saturation effect with the paramagnetic resonance absorption in the case in which the constant magnetic field is orientated parallel

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The Measurement of the Spin-Lattice Relaxation-Time of Cr^{+++} SOV/56-34-3-52/55
in Corundum
to the axis of the crystal. The values of the time of the
spin-lattice-relaxation $T_1 = 1.4 \cdot 10^{-7}$ sec for $T = 300^{\circ}K$
and $T_1 = 7 \cdot 10^{-4}$ sec for $T = 77^{\circ}K$, which were obtained here,
lead to the following conclusion: The fundamental mechanism
of relaxation within this temperature interval is the pro-
cess of "combination scattering" which leads to a temperature
dependence of the time of the spin-lattice-relaxation on
the kind $T_1 \sim T^{-7}$. There are 2 references, 1 of which is
Soviet.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR
(Physics Institute imeni P. N. Lebedev AS USSR)

SUBMITTED: December 28, 1957

Card 2/2

AUTHORS: Zverev, G. M.; Prokhorov, A. M.   56-34-4-48/60

TITLE: The Paramagnetic Electron Resonance of the Ion V^{3+} in
                Corundum (Elektronnyy paramagnitnyy rezonans iona V^{3+} v korunde)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958,
                Vol. 34, Nr 4, pp. 1023 - 1024 (USSR)

ABSTRACT: The authors investigated the spectrum of the paramagnetic
                electron resonance of the ion V^{3+} in a monocrystal of the
                corundum Al_2O_3. The spectroscopic basic state of this ion
                is $^3F_2$. The seven times degenerated orbital energetic level
                is split up by the electric field of the crystal into a
                singlet and a triplet, the triplet being the lowest level.
                This applies to crystal fields of cubic symmetry. A crystal
                field of trigonal or tetragonal symmetry further splits up
                this orbital triplet into a doublet and a singlet. The low-
                est energy level of the ion V^{3+} in a crystal field of tri-
                gonal symmetry is a singlet ($S = 1$), degenerated three times
Card 1/3   with regard to the spin. A line would have to be observed
                which corresponds to the transition from the level $S_z = + 1$

The Paramagnetic Electron Resonance of the Ion V^{3+} in Corundum   56-34-4-48/60

Card 2/3

to the level $S_z = 0$. In order to be able to investigate this line its width must not be too great, i.e. the time of the spin-lattice relaxation must be more than 10^{-11} sec. In the lattice of corundum there exists a strong electric field of trigonal symmetry which drives the lower orbital levels of the ion V^{3+} far apart. Therefore the time of spin lattice relaxation is probably sufficiently long at low tem-peratures. In such crystal lattices, in which the axial com-ponent of the electric field is weaker, the lines of para-magnetic electron relaxation are probably not easily visible. The authors observed a line of the ion V^{3+} in a corundum monocrystal at $T = 4.2^\circ K$ at frequencies of from 14 000 to 38 000 megacycles. When the temperature dropped to $2^\circ K$ the intensity of this line decreased considerably. When the tem-perature rose, the line became wider and then disappeared. At $T = 77^\circ K$ this line was not observed. The line consisted of 8 equidistant components, which corresponds to the nuclear spin $I = 7/2$ of V^{51}. The line was visible at parallel orien-tation. The half life component of a single component was 20 Oersted at parallel orientation and the distance between the components amounted to 108 Oersted. The spectrum can be

The Paramagnetic Electron Resonance of the Ion V^{3+} in Corundum   56-34-4-48/60

interpreted by means of a given spin Hamiltonian. The authors
thanked S. M. Grum-Grzhimaylo and A. A. Popova for the
production of the samples and Prof ssor A. I. Shal'nikov
for his aid in   carrying out   experiments at low tem-
peratures. There are 4 references, 0 of which are Soviet.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet
(Moscow State University)

SUBMITTED: January 16, 1958

1. Corundum--Resonance

Card 3/3

AUTHOR: Prokhorov, A. M.   SOV/55-34-6-49/51

TITLE: On a Molecular Amplifier and on a Generator on the Basis of
                 Sub-Millimeter Waves (O molekulyarnom usilitele i
                 generatore na submillimetrovykh volnakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958,
                 Vol. 34, Nr 6, pp. 1658-1659 (USSR)

ABSTRACT: This paper discusses the possibility of constructing such a
                 molecular amplifier and generator by using ammonia molecules.
                 The rotational transitions of the NH_3 molecule lie in the
                 region of the sub-millimeter waves, and they may be used for
                 the construction of a molecular amplifier and generator. The
                 rotation transitions are classified simultaneously with the
                 inversion levels. For the construction of the amplifier the
                 author used a device in which the radiation (which comes out
                 from one of the mouthpieces (rupor)) crosses some molecular
                 beams and then enters the other mouthpiece. An expression is
                 given for the coefficient of the negative absorption. For the
                 construction of a molecular generator (which can be used as a
Card 1/2   resonator) 2 plane-parallel mirrors may be used. An expression

On a Molecular Amplifier and on a Generator on   SOV/56-34-6-49/51
the Basis of Sum-Millimeter Waves

> is derived for the Q-factor of such a system. At last, an
> expression for the self-excitation is given.
> There is 1 figure.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva Akademii nauk SSSR
                (Physics Institute imeni P.N. Lebedev, AS USSR)

SUBMITTED: April 1, 1958

Card 2/2

SOV/56-34-6-50/51

AUTHORS: Zverev, G. M., Korniyenko, L. S., Manenkov, A. A.,
               Prokhorov, A. M.

TITLE: A Paramagnetic Amplifier and Generator on the Basis of Chromic
               Corundum (Paramagnitnyy usilitel' i generator na khromovom
               korunde)

ABSTRACT: The spectrum of Cr^{3+} in corundum was investigated in previous
               papers (Refs 6-9). The ion Cr^{3+} within the corundum is placed
               in an axial electromagnetic field which splits up the spin
               quadruplet of the lower singlet orbital level into 2 dublets
               with the distance $2D = - 0,3824$ cm^{-1} between them. For the
               construction of the paramagnetic amplifier the authors use
               the levels which (in the case that the crystal axis is orient-
               ated parallelly to the external constant paramagnetic field)
               are characterized by the quantum numbers $M = 3/2, \pm 1/2$. If
               the crystal axis is turned the states are intermixed and the
               transitions between all 3 levels are allowed. The levels

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A Paramagnetic Amplifier and Generator on the Basis of Chromic Corundum

SOV/56-34-6-50/51

$M = -1/2, 1/2$ are used for the amplification and the auxiliary radiations excitate the transitions between the levels $M = 1/2, -3/2$. The frequency at which the amplification (or the generation) is carried out is equal to ~ 3000 megacycles and the frequency of the auxiliary radiation was equal to ~ 15000 megacycles. At $T \sim 2^\circ K$ the system was excitated by itself and changed over to the function of a generator. The exact data concerning this amplifier will be published later. The authors thank A. I. Shal'nikov for his help in carrying out the experiments at low temperatures. There are 1 figure and 10 references, 6 of which are Soviet.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva Akademii nauk SSSR (Physics Institute imeni P.N. Lebedev, AS USSR)

SUBMITTED: April 1, 1958

Card 2/2

PROKHOROV, A.M.

SOV/5245

PHASE I BOOK EXPLOITATION

Ministerstvo svyazi SSSR. Tekhnicheskoye upravleniye

Novyye razrabotki v oblasti radiosvyazi i radioveshchaniya; in-
formatsionnyy sbornik (New Developments in the Field of Radio
Communication and Radio Broadcasting; Informational Collection)
Moscow, Svyaz'izdat, 1959. 80 p. 11,500 copies printed. (Series:
Tekhnika svyazi)

Resp. Ed.: A. S. Vladimirov; Ed.: V. I. Bashur; Tech. Ed.: G. I.
Shafer.

PURPOSE: This collection of articles is intended for technical per-
sonnel concerned with the development and operation of radio
communication and radio broadcasting.

COVERAGE: The book contains, according to the Foreword, information
on new developments realized at the Gosudarstvennyy nauchno-
issledovatel'skiy institut Ministerstva svyazi SSSR (State
Scientific Research Institute of the Ministry of Communication
USSR). Radio communication and radio broadcasting apparatus are
described. Several articles are concerned with the development
of new checking and measuring instruments. No personalities
are mentioned. There are no references.

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PROKHOROV   A. M.

В. Г. Дубовицкий,
А. Н. Козин

Прямо показывающие приборы для записи характеристик согласования

А. Н. Каргинов

Некоторые технические применения фотоструктивных методов измерения неэлектрических величин

В. В. Казакин,
Е. А. Комиссаров,
Г. П. Мигалкин,
П. А. Яковлев

Опыт разработки микрополосного радиоспектрометра

М. С. Стиканов

Некоторые приборы для автоматизации производственных измерений элементов аппаратуры дальней связи

11 июня
(с 18 до 22 часов)

М. В. Фомин

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Вопросы методики измерения и аппаратурного решения при измерении группового времени запаздывания на СВЧ и видеочастотах

Е. М. Штыб,
В. И. Борисов,
Д. А. Пелиберова

Использование импульсной модуляции для измерения временных характеристик

А. М. Чернушенко

Установка для исследования высокочастотных трактов и запаздывания систем электрическими импульсами

Н. Н. Бабин,
В. Я. Лаонов

Прибор для визуального наблюдения модуля коэффициента передачи четырехполюсника в диапазоне частот

9. СЕКЦИЯ ОБЩЕЙ РАДИОТЕХНИКИ
Руководитель Г. А. Левин

9 июня
(с 10 до 12 часов)

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report submitted for the Centennial Meeting of the Scientific Technological Society of Radio Engineering and Electrical Communications im. A. S. Popov (VNORIE), Moscow,
8-12 June. 1957

24,7900

66373

AUTHOR: Kaytmazov,.S.D. and Prokhorov, A.M.   SOV/120-59-5-24/46

TITLE: Resonators for the Observation of Electron Paramagnetic
            Resonance at Low Temperatures

PERIODICAL: Pribory i tekhnika eksperimenta, 1959, Nr 5,
            pp 107 - 110 (USSR)

ABSTRACT: Resonators are described which may be used for the
            observation of electron paramagnetic resonance at low
            temperature in the centimetre (λ = 2.5 and λ = 3.2 cm)
            and decimetre wavelength ranges. The resonators had to
            satisfy the following conditions.
            1) They should be small enough to be placed in a standard
            1-litre dewar (internal diameter 60 mm).
            2) It should be possible to place the specimen in the
            cooled resonator and to change specimens conveniently and
            rapidly in a cooled resonator.
            3) It should be possible to study unstable specimens in
            sealed-off quartz containers.
            4) It should be possible to tune the resonator in situ.
            5) It should be possible to rotate the specimen relative
Card1/3   to the direction of the magnetic field, which is necessary

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Resonators for the Observation of Electron Paramagnetic Resonance at Low Temperatures

in studying anisotropic materials. Since it is impossible to satisfy conditions 2, 3 and 4 at the same time in the rectangular resonator, a cylindrical resonator working with the H_{011} wave was chosen (Figure 1, 1). The resonator is excited through the coupling 4 and the energy is fed in through the rectangular waveguide 5, having a cross-section of 17×8 mm^2. In the upper part, the waveguide and a tube for the specimen are sealed into the cover of the dewar 6. The resonator is tuned by displacing the piston 13. The resonator set-up shown in Figure 1 was designed for $\lambda = 2.5$. Figure 2 shows the device for the decimetre range. In this case, a quarter-wave coaxial resonator is used. The inner surfaces are silver-plated and polished and the specimen is placed in the container 7. The overall volume of the resonator is about 1 litre. The resonator is evacuated through the tube 5 and it is supplied by the coaxial lines 4. The distance between the end of the central conductor 1a and the receiver head 2 is about 10 mm. Two resonators have been built, one

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SOV/120-59-5-24/46

Resonators for the Observation of Electron Paramagnetic Resonance at Low Temperatures

for $\lambda = 22.8$ cm with a central conductor 53 mm long and the other for $\lambda = 35$ and 11.6 cm, with the central conductor 83.5 mm long. G.V. Mishukov is thanked for for the mechanical design of the resonators. There are 2 figures and 4 references, 3 of which are Soviet and 1 English.

ASSOCIATION: Fizicheskiy institut AN SSSR (Physics Institute of the Ac.Sc., USSR)

SUBMITTED: September 6, 1958

Card 3/3

SOV/56-36-2-62/63

24(3)
AUTHORS: Zverev, G. M., Prokhorov, A. M.

TITLE: The Electron Paramagnetic Resonance of Co^{2+} in Corundum
                  (Elektronnyy paramagnitnyy rezonans Co^{2+} v korunde)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959,
                  Vol 36, Nr 2, pp 647-649 (USSR)

ABSTRACT: In a corundum single crystal which contains admixtures of
                  cobalt, the lines of the paramagnetic electron resonance of
                  the cobalt ion were detected at $T = 4.2°K$ at the frequencies
                  9800 and 37500 megacycles. All these lines have a hyperfine
                  structure of 8 components, which corresponds to the spin
                  $I = 7/2$ of the nucleus Co^{59}. If the magnetic field is parallel
                  to the trigonal axis of the crystal, an intense line is ob-
                  served, the components of which (for the frequency 9800 mega-
                  cycles), have very different distances. If the magnetic field
                  is perpendicular to the trigonal axis, the components of the
                  hyperfine structure of these lines are equidistant for both
                  of the above-mentioned frequencies. The observed spectrum can
                  be ascribed to Co^{2+} of effective spin $S' = 1/2$. The hyperfine
                  structure was not investigated in detail; the g-factors

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SOV/56-36-2-62/63

The Electron Paramagnetic Resonance of Co^{2+} in Corundum

(measured in the center of the line) have the values $g_{\shortparallel} = 2.27$ and $g_{\perp} = 4.95$. Besides an intense line, some faint lines are observed which have the hyperfine structure characteristic of cobalt. In contrast to the ions Cr^+, Fe^{3+}, V^{3+} in corundum, the ion Co^{2+} has a noticeably longer relaxation time, since at $T = 4.2^{\circ}K$ the saturation effect takes place at powers of $\sim 10^{-8}$ W. This is a translation of this short letter.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvemogo universiteta (Institute of Nuclear Physics of Moscow State University)

SUBMITTED: December 16, 1958

Card 2/2

SOV/56-36-3-41/71

21(1)
AUTHORS: Korniyenko, L. S., Prokhorov, A. M.

TITLE: A Paramagnetic Amplifier and Generator with Fe^{3+}-Ions in
             Corundum (Paramagnitnyy usilitel' i generator na ionakh Fe^{3+}
             v korunde)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959,
             Vol 36, Nr 3, pp 919-920 (USSR)

ABSTRACT: In this "Letter to the Editor" the authors publish the results
             obtained by their investigations of the possibility of pro-
             ducing a Fe^{3+}-ion amplifier and -generator. The electron
             spectrum of the paramagnetic resonance of these ions in the
             Al_2O_3-lattice has already been investigated in a previous
             paper (Ref 9). The Fe^{3+}-ion is in the s-state and has the
             electron spin S = 5/2; in corundum it forms two noneqivalent
             systems. For the case of the presence and absence of the
             external magnetic field details of the energy- and spin levels
             of these systems are discussed. For the distance of the
             3 doublets of the 6 spin levels of the individual systems in
             the absence of the external magnetic field the values

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SOV/56-36-3-41/71

A Paramagnetic Amplifier and Generator with Fe^{3+}-Ions in Corundum

0.39 and 0.62 cm^{-1} are given. From the intensity ratio of spectral lines at 290 and 4.2°K it is concluded that the lowest spin doublet in strong magnetic fields splits up to levels to which the magnetic quantum numbers $M = \pm 1/2$ correspond, i. e. the sign of the constants of the spin Hamiltonian D is positive. For the paramagnetic amplifier such levels were used as were characterized by the quantum numbers $M = -5/2$, $-3/2$, and $-1/2$. For amplification the levels with $M = -3/2$, $-1/2$ and the transitions induced by auxiliary radiation between the levels with $M = -5/2$, $-1/2$ were used. Amplification and production were observed at 1.8°K on the 3.2 cm wave (auxiliary radiation ~1.2 cm). The constant magnetic field had an intensity of ~1200 oersted. There are 9 references, 2 of which are Soviet.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: November 27, 1958

Card 2/2

SOV/56-36-4-67/70

24(3), 24(7)
AUTHORS:

Kaytmazov, S. D., Prokhorov, A. M.

TITLE:

Electron Paramagnetic Resonance Spectra of Frozen-in OH-radicals (Spektry elektronnogo paramagnitnogo rezonansa zamorozhennykh radikalov OH)

PERIODICAL:

Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 4, pp 1331-1332 (USSR)

ABSTRACT:

The authors already investigated the electron paramagnetic resonance (e.p.r.) spectra of radicals in H_2O- and H_2O_2-vapors in electric discharges and also reported results (Refs 1,2). In the present "Letter to the Editor" they give a short report on investigations of such spectra which had been recorded during the ultraviolet irradiation of frozen-in H_2O_2 (at $T = 77°K$). Irradiation was carried out by means of a mercury vapor lamp of the SVDSh-1000 type. That OH was concerned in the case of the radicals recorded was concluded from the fact that in the spectrum no quanta which would have been able to destroy an O-H bond were found. As the spectrum did not depend on the acid concentration in the aqueous solution (5 - 98%), it could be assumed that no

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SOV/56-36-4-67/70

'Electron Paramagnetic Resonance Spectra of Frozen-in OH-radicals

secondary reactions occurred. The e.p.r. spectra were recorded
at the frequencies 12000, 9400, 2600, 1300, and 850 megacycles;
the spectra showed agreement with those recorded in discharges
At 850 megacycles a doublet with a distance of $(12 \pm 1)G$
between the components was found. At 12000 megacycles a figure
shows the absorption line. The shape of the line may well be
explained by assuming the existence of an anisotropic widening
and a hyperfine splitting. There are 1 figure and 3 references,
1 of which is Soviet.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR
                (Physics Institute imeni P. N. Lebedev of the Academy of Sci-
                ences, USSR)

SUBMITTED: February 12, 1959

Card 2/2

PROKHOROV, A. M., TRAPEZNIKOV, Z. A., ANTONOV-ROMANOVSKIY, V. V., and DUBININ, V. G.

Detection of Ionization of Eu++ in the Phosphor SrS-Eu, Sm
by the Paramagnetic Resonance Absorption Method

V. V. Antonov-Romanovsky, V. G. Dubinin, A. M. Prokhorov, Z. A. Trapeznikova, and M. V. Fock, P. N. Lebedev Physical Institute, Academy of Sciences of the U.S.S.R., Moscow, U.S.S.R.

When the phosphor SrS-Eu, Sm is under excitation, the paramagnetic absorption caused by Eu++ ions decreases appreciably (approximately to 15%). Decrease of the amount of Eu+ during excitation may depend either on electron trapping by Eu++ion or on its further ionization, i.e., on its transition to a trivalent state. The second alternative seems to be the most probable.

Report presented at the 117th Meeting of the Electrochemical Society, Chicago, 1-5 May 1960.

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S/030/60/000/04/15/028
B022/B007

9.4300 24.7600

AUTHORS: Basov, N.G., Doctor of Physical and Mathematical Sciences,
            Prokhorev, A.M., Doctor of Physical and Mathematical Sciences

TITLE: Quantum Radio-physics - Authors' Lecture

PERIODICAL: Vestnik Akademii nauk SSSR, 1960, No. 4, pp. 110-119

TEXT: The practical application of quantum radio-physics for the generation
and amplification of electromechanical waves was worked out at the Fizicheskiy
institut im. P.N. Lebedeva Akademii nauk SSSR (Physics Institute imeni
P.N. Lebedev of the Academy of Sciences of the USSR), and the Institut
radiotekhniki i elektroniki Akademii nauk SSSR (Institute of Radio-engineering
and Electronics of the Academy of Sciences of the USSR). A quantum system with
two energy levels is dealt with (Fig. 1). In interaction with an external electro-
magnetic field this system is able to absorb and to emit energy quanta. Three
processes developing here, viz. resonance absorption, induced emission, and
spontaneous radiation, are mentioned, in which case equilibrium is established
between the molecules and the quanta of the field. The scheme of a molecular

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Quantum Radio-physics - Authors' Lecture

generator for the emission of a beam of ammonia molecules with negative tempera-
ture is shown in Fig. 2 and the generator itself in Fig. 3. The generator
consists of three main parts, namely the source of the molecule beam, the
sorting system in form of a cylindrical condenser, and the oscillation circuit -
a so-called cavity resonator frequently used in the range of centimeter waves,
and characterized by an exceedingly high frequency stability. As working material
crystals are used in molecular amplifiers, which contain paramagnetic ions,
which was first suggested by Ye.K. Zavoyskiy. The scheme of such an amplifier
is shown in Fig. 4. For the purpose of obtaining a negative temperature in the
paramagnetic crystals, an auxiliary radiation is used (Fig. 5). The paramagnetic
amplifiers are able to work at the temperature of liquid helium $(T - 4.2^{\circ}K)$. The
possibility is, however, pointed out of using parameter amplifiers. A para-
magnetic amplifier without magnet and cryostat is shown in Fig. 6. Methods of
obtaining negative temperatures in semiconductor systems are developed, investiga-
tions are carried out in the region of submillimeter waves, and experiments with
respect to the increase in the sensitivity of receivers are made, in which
molecular amplifiers were used. There are 6 figures.

Card 2/2

31757
S/058/61/000/011/010/025
A058/A101

24.7900

AUTHORS: Zverev, G.M., Korniyenko, L.S., Prokhorov, A.M.

TITLE: Investigation of electron paramagnetic resonance of iron-group ions
in corundum

PERIODICAL: Referativnyy zhurnal. Fizika, no. 11, 1961, 130, abstract 11V267 (V
sb. "Paramagnitn. rezonans". Kazan', Kazansk. un-t, 1960, 7)

TEXT: The electron paramagnetic resonance of Fe, Co, V, Cr and Cu ions in
the corundum lattice was experimentally investigated in a wide frequency (40,000-
10,000 Mcps) and temperature (290°-1.7°K) range. The observed spectra were give:
a pertinent theoretical interpretation, and the values of the spin Hamiltonian
constants were determined. Electron paramagnetic resonance of Cu ions in corundum
was not detected. The valence states of ions in corundum were determined, and
relaxation times at liquid He temperature were evaluated. The feasibility of
using Cr and Fe ions in corundum to design paramagnetic amplifiers was experimen-
tally demonstrated.

[Abstracter's note: Complete translation]

Card 1/1

69843

5.4/30

S/051/60/008/03/030/038
E201/E191

AUTHOR: Prokhorov, A.M., and Shipulo, G.P.

TITLE: A Radio-Spectroscopic Investigation of the F_3BNH_3 and $F_3BN(CH_3)_3$ Molecules

PERIODICAL: Optika i spektroskopiya, 1960, Vol 8, Nr 3, p 419 (USSR)

ABSTRACT: The F_3BNH_3 and $F_3BN(CH_3)_3$ molecules have the configurations of symmetrical tops. Their rotational spectra were investigated by the authors in the vapour phase using a radio-spectroscope with electrical molecular modulation and an absorption cell capable of standing temperatures up to 200 oC. No absorption lines of F_3BNH_3 were found in the region 9000-35000 Mc/s because in the vapour phase this molecule is strongly dissociated into BF_3 and NH_3. For the $F_3BN(CH_3)_3$ molecule 10 rotational transitions were found in the region 7000-35000 Mc/s. A rotational constant B was found to be 1750 Mc/s which differed by only 4% from the theoretical value [for $F_3BN(CH_3)_3$ in the solid phase this constant was reported as B = 1830 Mc/s (Ref 1)]. For the 2—3 transition of $F_3BN(CH_3)_3$ the dipole moment was estimated

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S/051/60/008/03/030/038
B201/B191

A Radio-Spectroscopic Investigation of the F_3BNH_3 and $F_3BN(CH_3)_3$
Molecules

to be 5 Debye units. The complex nature of the observed
rotational transitions of $F_3BN(CH_3)_3$ is primarily due to
the non-rigidity of the molecule and the presence of the
F_3B and $N(CH_3)_3$ groups in it which can execute torsional

Card
2/2

vibrations. Moreover each rotational transition may
have structure due to isotopes B^{11} (81%) and B^{10} (19%).

There are 4 references, of which 2 are Soviet and
2 English.

SUBMITTED: October 9, 1959

68347

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5(4), 24(7)

S/076/60/034/01/040/044
B004/B007

AUTHORS: Kaytmazov, S. D., Prokhorov, A. M.

TITLE: The Spectrum of the Electron Paramagnetic Resonance of a
              Free Radical, Obtained by Irradiation of H_2O_2 With Ultravio-
              let Light

PERIODICAL: Zhurnal fizicheskoy khimii, 1960, Vol 34, Nr 1, pp 227 - 228
              (USSR)

ABSTRACT: In an earlier paper (Ref 1), the authors, together with
              A. B. Tsentsiper, investigated the electron paramagnetic re-
              sonance (epr) spectra of radicals which they obtained by
              freezing-in the products of the electric discharge in H_2O-
              and H_2O_2-vapor. Because of the high energy of the discharge,
              which was able to separate various bonds, the radical formed
              could not be identified. The authors now deal with the irradia-
              tion of 98% H_2O_2 with the ultraviolet light of a mercury lamp
              of the type SVDSh-1000 (1000 w) at freezing temperature of
              H_2O_2. As the energy of the O-H-bond is 110 kcal/mol, which
              corresponds to a light quantum of 2600 Å, and as the spectrum
              of the mercury lamp used does not contain waves of such short-

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The Spectrum of the Electron Paramagnetic
Resonance of a Free Radical, Obtained by
Irradiation of H_2O_2 With Ultraviolet Light

S/076/60/034/01/040/044
B004/B007

ness, the formation of $HO_2^{\cdot}$- and H°-radicals is considered to
be improbable. The authors assume that they observed OH°-
radicals, the formation of which is possible on the basis of
the energy of the O-O-bond in H_2O_2. Figure 1 shows the epr
spectrum at 12,000 megacycles of the radical formed in the dis-
charge and that formed during UV-irradiation. The congruence
of both spectra confirms the formation of the OH°-radical. At
850 megacycles a doublet (Fig 2) is formed, which is due to
the superfine structure of the proton. This doublet undergoes
a change after heating and renewed cooling to $77^{\circ}K$ (Fig 2).
No explanation of this phenomenon has as yet been found. The
concentration of the free radical in a sample irradiated for
10 hrs was 5%, it was less in the case of samples irradiated
for shorter periods. The authors expect to be able to attain
even higher concentrations if the duration of irradiation is
further increased. There are 2 figures and 4 references, 1 of
which is Soviet.

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Physics Inst. im P. N. Lebedev AS USSR

Prokhorov, A.M.

24.7900

82020
S/056/60/038/02/21/061
B006/B011

AUTHORS: Zverev, G. M., Prokhorov, A. M.

TITLE: Investigation of the Spectrum of Electron Paramagnetic Resonance of V^{3+} in Corundum

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 38, No. 2, pp. 449-454

TEXT: A previous paper (Ref. 1) had already reported on the investigations of the electron paramagnetic resonance spectrum in a corundum single crystal containing 0.13% V^{3+}. The present paper offers detailed information, and first of all, an interpretation of experimental results by the aid of the spin Hamiltonian, which describes the behavior of the three lowest energy levels in the magnetic field. The introduction offers several data concerning the free V^{3+} ion and the vanadium ion inserted in the crystal structure of Al_2O_3, and a few general structural problems are discussed. The splitting of the lowest energy level of the V^{3+} ion in fields of different symmetry had already been investigated to explain the magnetic behavior of vanadium alum. The level degeneration is schematically re-

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Investigation of the Spectrum of Electron   S/056/60/038/02/21/061
Paramagnetic Resonance of V^{3+} in Corundum   B006/B011

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presented in Fig. 1 and is discussed (level splitting into a singlet and
two triplets). The spin-orbit interaction gives rise to a further split-
ting of the lower spin triplet into a singlet and a doublet (Refs. 4-6).
The degeneration of the spin triplet is, however, completely eliminated
on the contamination of a crystal with rhombic symmetry - which in fact
occurs with corundum. Since already at room temperature, and all the more
at lower temperatures, all of the energy levels except for the lowest are
not populated, only the lower three spin levels are of interest for the
electron paramagnetic resonance. Transitions among these three spin levels
can be observed by the method of the electron paramagnetic resonance.
Fig. 3 shows the picture of such a resonance line of the V^{3+} ion in
corundum at $\nu = 37.450$ Mc/sec, $T = 4.2^{\circ}K$. There were also
Cr^{3+} and Fe^{3+} ions in corundum, but their concentration did not exceed
0.001%. Measurements had already been made in a wide frequency range
(9,000 - 39,000 Mc/sec) at helium temperature. Such a resonance line
(Fig. 3) consisted of eight hyperfine structural components each, which
is indicative of a nuclear spin of the V^{51} of $I = 7/2$. The Hamiltonian

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Investigation of the Spectrum of Electron   S/056/60/038/02/21/061
Paramagnetic Resonance of V^{3+} in Corundum   B006/B011

by which the experimental results were studied, reads

$$\hat{\mathcal{H}} = D\hat{S}_z'^2 + g_{\|}\beta H_z\hat{S}_z' + g_{\perp}\beta(H_x\hat{S}_x' + H_y\hat{S}_y') + A\hat{S}_z'\hat{I}_z + B(\hat{S}_x'\hat{I}_x + \hat{S}_y'\hat{I}_y) + E(\hat{S}_x'^2 - \hat{S}_y'^2),$$

where $\hat{S}_x'$, $\hat{S}_y'$, and $\hat{S}_z'$ are the projections of the effective electron

spin, $\hat{I}_x$, $\hat{I}_y$, and $\hat{I}_z$ the projections of the nuclear spin, H_x, H_y, and
H_z the projections of the field strength vector, $g_{\|}$ and $g_{\perp}$ the factors
of the spectroscopic splitting, β the Bohr magneton, D the constant
of primary splitting, E the constant of the rhombic field; A and B are
constants of the hyperfine structure. The constants of the Hamiltonian
were found by the authors to be

$g_{\|}$ = 1.915 $\pm$ 0.002; D = (7.0 $\pm$ 0.3) cm^{-1}, $|A|$ = (0.959 $\pm$ 0.005)$\cdot10^{-2}cm^{-1}$;

$|E|< 10^{-2}cm^{-1}$. The results are discussed. The authors finally thank
A. A. Popova, R. P. Bashuk, and A. S. Bebchuk for their assistance.
There are 4 figures and 11 references: 5 Soviet, 2 Dutch, 2 British, and

Card 3/4   _Inst. Nuclear Physics, Moscow State Univ._ //

MANENKOV, A.A.; PROKHOROV, A.M.

Spin-lattice relaxation in chromium corundum. Zhur.eksp.i
teor.fiz. 38 no.3:729-733 Mr '60.   (MIRA 13:7)

1. Fizicheskiy institut im. P.N.Lebedeva Akademii nauk
SSSR.
            (Nuclear magnetic resonance)
               (Corundum)

83615

S/056/60/038/005/048/050
B006/B063

24.7900

AUTHORS: Korniyenko, L. S., Prokhorov, A. M.

TITLE: Electron Paramagnetic Resonance of the Ti^{3+} Ion in Corundum

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960,
             Vol. 38, No. 5, pp. 1651 - 1652

TEXT: Electron paramagnetic resonance of Ti^{3+} ions has hitherto been observed only in iron-titanium alum. The authors stressed the difficulties of interpreting the results obtained. In the present work, the authors have found e.p.r. in Ti^{3+} ions at the temperature of liquid helium. These ions were isomorphously introduced into Al_2O_3. Three samples having a mean titanium concentration of some hundredths at% were examined at a wavelength of ~ 3 cm. One slightly asymmetric e.p.r. line (cf. photograph) was found. The behavior of this line with a change of the angle θ between the direction of the constant H-field and the trigonal axis of the electric field of the crystal is theoretically studied with the spin Hamiltonian, and the g-factors are calculated and estimated to

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83615

Electron Paramagnetic Resonance of the Ti^{3+} Ion $S/056/60/038/005/048/050$
in Corundum $B006/B063$

be $g_{\parallel} = 1.067 \pm 0.001$ and $g_{\perp} \leq 0.1$, respectively. The e.p.r line width of
Ti^{3+} ions in corundum at $\theta = 0°$ was determined to be 50 oe. The shape and
width of this line do not change when temperature drops to $1.55°K$. An
investigation of the dependence of the line width on θ shows a considerable
deviation from the law $\Delta H = h\Delta\nu/g$, where $\Delta H = const/\cos\theta$ holds. The line
is considerably broadened by heating the sample at about $9°K$. Thus, one
obtains a spin-lattice relaxation time of $\sim 5.10^{-8}$ sec at this temperature.
As is shown by measurements of $4.2°K$ ($\sim 10^{-4}$ sec) and $1.55°K$ ($\sim 10^{-1}$ sec),
the relaxation time is highly temperature-dependent also in this case. The
authors thank R. P. Bashuk, A. S. Bebchuk, and A. A. Popova for preparing
the samples, and G. M. Zverev for discussions. There are 1 figure and
4 references: 1 Soviet and 3 British.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo uni-
              versiteta (Institute of Nuclear Physics of Moscow State
              University)

SUBMITTED: March 21, 1960

Card 2/2

Pro K Horov, A. M.

82600

S/056/60/039/01/08/029
B006/B070

24.6400

AUTHORS: Zverev, G. M., Prokhorov, A. M.

TITLE: Electron Paramagnetic Resonance and Spin Lattice Relaxation
             of the Co^{2+} Ion in Corundum

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960,
             Vol. 39, No. 1 (7), pp. 57-63

TEXT: The purpose of the present work was an investigation of the
electron paramagnetic resonance of the Co^{2+} ion in corundum, its
theoretical interpretation, and a determination of the spin lattice
relaxation time. The energy levels of the Co^{2+} ion which, as a free ion
in the ground state, has a ^4F term corresponding to the $3d^7$ configura-
tion, are split in the corundum crystal by the Stark effect of the
electric field of the neighboring ions. The electric field in the
crystal is formed by the O^{2-} octahedron, and has mainly cubic symmetry
with slight trigonal impurities. The behavior of the Co^{2+} ion in the

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82600

Electron Paramagnetic Resonance and Spin Lattice S/056/60/039/01/08/029
Relaxation of the Co^{2+} Ion in Corundum   B006/B070

crystal field, and the splitting of the line are investigated in the
introduction. The experimental results are then mentioned (Which have
partly already been published in Ref. 8). The spectrum of the electron
paramagnetic resonance of Co^{2+} was investigated at $4.2^{\circ}K$. It consists of
two groups of strong lines which show eight hyperfine-structure components
($I=7/2$ for Co^{59}), and some groups of weak lines characteristic of cobalt
hyperfine-structure. The intensities of all lines diminish with decreas-
ing temperature; that means that the lines are due to transitions between
levels of the lower Kramers doublet. For the constants of the spin
Hamiltonian of the lines 9000 and 38000 Mc/sec, the following values
were found:
Line I
$g_{\parallel} = 2.292 \pm 0.001$ $g_{\perp} = 4.947 \pm 0.003$

$A = 3.24 \pm 0.01$ $B = 9.72 \pm 0.05$
Line II
$g_{\parallel} = 2.808 \pm 0.003$ $g_{\perp} = 4.855 \pm 0.005$

$A = 2.08 \pm 0.09$ $B = 15.10 \pm 0.11$ (A and B in 10^{-3} cm^{-1})

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82600

Electron Paramagnetic Resonance and Spin Lattice   S/056/60/039/01/08/029
Relaxation of the Co^{2+} Ion in Corundum   B006/B070

Fig. 1 shows lines I and II for parallel orientation, the magnetic field increasing from left to right. The lines I and II belong to different non-equivalent ion systems. The existence of the two ion systems of Co^{2+} in corundum is then discussed on the basis of the lattice system shown in Fig. 2. At the same time, brief mention is made of the calculation of the hyperfine structure constants A and B. The spin lattice relaxation time τ_1 in corundum for a cobalt concentration of $10^{-2}\%$ at helium temperature was determined by the method of saturation of the resonance lines. At 4.2°K, τ_1 was found to be 1 sec which is abnormally high, while, at 22°K it was only 3.10^{-8} sec. Fig. 3 shows the temperature dependence of τ_1. From 1.8 to 4.2°K, τ_1 is inversely proportional to temperature. Some details of the experimental method, and the temperature dependence of τ_1 are discussed at length. The authors thank P. N. Bashuk and A. S. Sebchuk for preparation of the samples and L. S. Kornivenko for discussions. There are 3 figures and 16 references: 4 Soviet, 9 American, 1 Dutch, and 2 British.

Card 3/4

PROKHOROV, A. M.

82613

S/056/60/039/001/029/029
B006/B063

24.6200
24.6520

AUTHORS: Zverev, G. M., Prokhorov, A. M.

TITLE: Electron Paramagnetic Resonance of Vanadium in Rutile

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960,
             Vol. 39, No. 1(7), pp. 222-223

TEXT: In TiO_2 containing a 0.01% vanadium impurity the authors
detected an electron paramagnetic resonance (e.p.r.) spectrum that
consisted of two lines showing a hyperfine structure (split into eight
components) characteristic of V^{51} (nuclear spin 7/2). For S = 1/2 and
I = 7/2 the e.p.r. spectrum of vanadium is represented by the spin
Hamiltonian $\hat{\mathcal{H}} = g_x\beta H_x\hat{S}_x + g_y\beta H_y\hat{S}_y + g_z\beta H_z\hat{S}_z + A_x\hat{I}_x\hat{S}_x + A_y\hat{I}_y\hat{S}_y + A_z\hat{I}_z\hat{S}_z$,
where g - anisotropy factor of the spectroscopic splitting, A - constant
of hyperfine structure, and β - Bohr magneton; z is in the tetragonal
axis, and x and y run parallel with the directions $[1\bar{1}0]$ and $[1\bar{1}0]$. The
following values were determined for the Hamiltonian constants at 77°K

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Electron Paramagnetic Resonance of   S/056/60/039/001/029/029
Vanadium in Rutile   B006/B063

and 9800 Mc/sec: $g_x = 1.955 \pm 0.001$, $g_y = 1.913 \pm 0.001$, $g_z = 1.912 \pm 0.001$; $A_x = 14.15 \pm 0.07$, $A_y = 3.09 \pm 0.03$, and $A_z = 4.41 \pm 0.03$. A_x, A_y, and A_z are given in 10^{-3}cm^{-1}. Other frequencies and temperatures yielded the same results, i.e., the constants were practically independent of temperature and frequency. At room temperature vanadium showed no e.p.r. in rutile. The lines became narrower with dropping temperature, and at 90°K their width was 3.5 oe, after which it remained constant. This width is supposed to be due to spin-spin interaction of paramagnetic vanadium ions. The spin-lattice relaxation of vanadium ions in rutile was measured by the method of continuous saturation. At 4.2°K it was 2.10^{-1}sec, and at 90°K, 6.10^{-6}sec. In the case of saturation, a line broadening was found at 90°K, which confirmed the above-mentioned assumption on the nature of the line width. All experiments indicate that vanadium is incorporated in the rutile lattice in the form of V^{4+} ions. R. P. Bashuk and A. S. Bebchuk are thanked for having supplied the specimens used. There are 3 non-Soviet references.

Card 2/3   *Inst. Nuclear Physics, Moscow State Univ.*

83758

S/056/60/039/003/003/045
B004/B060

$24.5600 (1035, 1055, 111 4)$

AUTHORS: Zverev, G. M., Prokhorov, A. M.

TITLE: The Cross Spin Relaxation in the Hyperfine Structure of the Electron Paramagnetic Resonance of Co^{2+} in Corundum

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 39, No. 3 (9), pp. 545 - 547

TEXT: The authors discuss the effect of cross relaxation (Refs. 1-4) occurring in spin systems with little differing resonance frequencies. They studied the cross spin relaxation of transitions corresponding to different projections of the nuclear spin. The corundum sample used contained 10^{-2} % of Co, the time T_1 of the spin-lattice relaxation was 1.2 sec at 4.2^{o}K. The trigonal axis of the crystal was parallel to $\vec{H}$ (outer magnetic field), the width of the individual components of the hyperfine structure was 7.5 oersteds, the distance between the components was 30 oersteds. The sample was placed into a resonator which was modulated to two close frequencies ν_1 and $\nu_2 \sim 9200$ Mc/sec. The

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The Cross Spin Relaxation in the Hyperfine
Structure of the Electron Paramagnetic
Resonance of Co^{2+} in Corundum

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lines of the electron paramagnetic resonance were observed at the
frequency ν_1 by means of a superheterodyne radiospectroscope. The
frequency ν_2 supplied the saturation pulse. The restoration of the line
intensity after switching off the saturation pulse was recorded by means
of a cinematographic camera. A figure illustrates the relation
$\log(J_0 - J) = f(t)$. J is the absorption intensity, proportional to the
filling n of the spin levels, J_0 is the absorption intensity in thermal
equilibrium. The curves are given for two cases: 1) All of the eight
components of the hyperfine structure were saturated to one level. The
relaxation is then expressed by $n_0 - n = A \exp(-t/T_1)$ (1). 2) Only an
outer component was saturated by a short pulse. The relaxation is in this
case faster due to spin-spin interaction. The calculation was made here
on the following assumption: a) the cross relaxation between each
neighboring component pair can be expressed by the same parameter T_{12},
the cross relaxation time; b) only the spin-spin interaction of
neighboring components is taken into account. The authors obtained

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The Cross Spin Relaxation in the Hyperfine   S/056/60/039/003/003/045
Structure of the Electron Paramagnetic   B004/B060
Resonance of Co^{2+} in Corundum

equation $n_o - n_i = \sum_{j=1}^{8} A_{ji} \cdot \exp(-\lambda_j t)$; $\lambda_j = 1/T_1 + c_j/T_{12}$. c_j are

constants, the coefficients A_{ji} are dependent on the experimental

conditions. The experimental data corresponded to a T_{12} of 0.27 sec.
While T_1 depends on temperature, T_{12} was constant between 1.8 and $4.2°K.$
There are 1 figure and 4 references: 1 Soviet and 3 US.

ASSOCIATION: Institut yadernoy fiziki Moskovskogo gosudarstvennogo
               universiteta (Institute of Nuclear Physics of Moscow
               State University)

SUBMITTED: April 9, 1960

Card 3/3

BARCHUKOV, A. I.; PROKHOROV, A. M.

" Investigation of disk resonators at super-high frequency "
Presented at 10th Annual Colloq. on Radioelectric Research
A. M. P. E. R. E.) Leipzig, 13-17 Sep. 1961

RYTOV, Sergey Mikhaylovich, prof., doktor fiziko-matem.nauk; MILLER,
Vladimir Viktorovich, kand.fiziko-matem.nauk; BASOV,
Nikolay Gennadiyevich, prof., doktor fiziko-matem.nauk;
PROKHOROV, Aleksandr Mikhaylovich, prof., doktor fiziko-matem.
nauk, laureat Leninskoy premii; FAYNBOYM, I.B., red.;
ATROSHCHENKO, L.Ye., tekhn.red.

[New problems in physics] Novye problemy fiziki; sbornik statei.
Moskva, Izd-vo "Znanie," 1961. 44 p. (Vsesoiuznoe obshchestvo
po rasprostraneniiu politicheskikh i nauchnykh znanii. Ser.9,
Fizika i khimiia, no.7)   (MIRA 14:6)
        (Astronautics)   (Relativity)

PROKHOROV, Aleksandr M.   (USSR)   Physics Institute imeni P. N. Lebedev, Moscow.

"Millimeter Wave Masers".   (Sessions V and VI).

report to be submitted for the 2nd Intl. Conference Quantum Electronics, Berkeley,
California, 23-25 Mar 61.

PASHININ, P.P.; PROKHOROV, A.M.

> Measuring the spin-lattice relaxation time in compounds with
> strong covalent bonds. Zhur. eksp. i teor. no.1:49-51 Ja '61.
>   (MIRA 14:6)
>
> 1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR.
>   (Paramagnetic resonance and relaxation)

21656

9.2570 (6—————————7—463)

AUTHORS: Karlov, N.V., Pimenov, Yu.P., and <u>Prokhorov, A.M.</u>

TITLE: Saturation and Recovery Time of Paramagnetic
              Amplifiers

PERIODICAL: Radiotekhnika i elektronika, 1961, Vol.6, No.3,
              pp. 410-415

TEXT: The purpose of this article is to determine the
dependence of gain factor on signal power, recovery time after
saturation, in dependence on gain factor, and methods of shortening
the latter in a three-level amplifier with signal transition
between levels 1 and 2 and pumping transition between level 1 and
3.   Under the effect of strong signals the gain decreases because
of changes in the populations N_2 and N_1.   This effect is studied
in resonator and travelling-wave paramagnetic amplifiers.   The
analysis leads to the conclusion that for any given amplifier the
dynamic characteristics can be improved only by reducing the
relaxation time.   Comparing the resonator and travelling-wave
amplifiers, the authors' calculations show that the latter are
somewhat less susceptible to saturation (Fig.1) where the broken

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S/109/61/006/003/011/018
E140/E135

Saturation and Recovery Time of Paramagnetic Amplifiers

lines correspond to the travelling-wave case, the solid line to
the resonator case.   Improvements in relaxation time may be
obtained by increasing the operating temperature, which it is
claimed has other beneficial effects, such as increase in the
energy density of the pumping field and increase in magnetic
quality.   A second possibility is the addition of paramagnetic
impurities which should reduce the "vacant" transition 2 - 3.
Certain other advantages of this procedure have been considered in
the literature (H.E.D. Scovil and G. Feher, Phys.Rev., 1957, 105,
762, Ref.5; and E.O. Schulz-Du Bois, H.E.D. Scovil and
R.W. De Grasse, Bell System Techn. J., 1959, 38, 335, Ref.6).
Analysis shows that reduction of the relaxation time by increasing
only a single relaxation probability permits obtaining the
maximum number of active molecules, and with lower pumping field
radiation, to improve the amplitude and relaxation characteristics
of the paramagnetic amplifier.
There are 2 figures and 6 references: 2 Soviet and 4 English.

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S/109/61/006/003/011/018
E140/E135

Saturation and Recovery Time ....

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR
(Physics Institute imeni P.N. Lebedev, AS USSR)

SUBMITTED: April 7, 1960

Fig. 1

Рис. 1
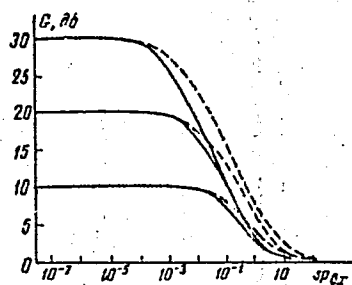
Card 3/3

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S/109/61/006/003/012/018
E140/E135

9,2570 (also 2503, 2603, 2903)

AUTHORS: Karlov, N.V., Pimenov, Yu.P., and Prokhorov, A.M.

TITLE: The Sensitivity of Radio Receivers With Paramagnetic Amplifiers

PERIODICAL: Radiotekhnika i elektronika, 1961, Vol.6, No.3, pp. 416-421

TEXT: In view of the low intrinsic noise of paramagnetic amplifiers it is useful to examine the possible gain in sensitivity for equipment employing them. Here distinction must be made between the reception of regular, practically monochromatic signals, and the reception of noise signals. The present calculations take this distinction into account. For the case of regular signal reception the use of the paramagnetic amplifier sharply improves the sensitivity, for specific numerical values considered by the author, up to factors of 40-80. In the case of noise receivers it is found that resonator type paramagnetic amplifiers are useful if the gain bandwidth factor is not less than that of the radiometer in the absence of the paramagnetic amplifier. At the same time resonator type paramagnetic amplifiers

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S/109/61/006/003/01^2/018
E140/E135

The Sensitivity of Radio Receivers With Paramagnetic Amplifiers

with gain above 20 dB do not operate sufficiently stably.   The
travelling-wave type paramagnetic amplifier, not as effective at
gains equal to 10 dB, gives theoretically better results above
20 dB, but also exhibits instabilities at the higher gain.
There are 2 figures and 4 references: 3 Soviet and 1 English.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR
               (Physics Institute imeni P.N. Lebedev, AS USSR)

SUBMITTED: April 7, 1960

Card 2/2

S/109/61/006/005/025/027
D201/D303

9. 9572

AUTHORS: Karlov, N.V., Pimenov, Yu.P., and Prokhorov, A.M.

TITLE: A 10 cm frequency band paramagnetic amplifier utilizing Fe^{3+} ions in corundum

PERIODICAL: Radiotekhnika i elektronika, v. 6, no. 5, 1961, 846

TEXT: It has been recently shown by experiment that the Fe^{3+} ions in corundum can be utilized in paramagnetic amplifiers in the 3 cm band of frequencies (Ref. 1: L.S. Kornivenko, A.M. Prokhorov, ZhETF, 1959, 36, 919) and (Ref. 2: J.E. King, K.W. Ternune, J. Appl. Phys. 1959, 30, 1844). It would be of interest to show that this material could be used for building a PПУ (RPU) in the 10 cm frequency band. For this application several levels of the Fe^{3+} ion could be used. The authors studied experimentally one level only, for which they used the resonant system of the paramagnetic amplifier already in hand. The trigonal axis of the crystallic

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S/109/61/006/005/025/027
D201/D303

A 10 cm frequency band ...

electric field was perpendicular to the external magnetic field.
In this case the energy levels of two non-equivalent systems of
Fe^{3+} ions coincide. The transition between lower levels was used
for amplification. These levels for parallel orientation could be
characterized by quantum numbers $M = \pm 1/2$. As the subsidiary tran-
sition $- 1/2 \longleftrightarrow - 3/2$ was used. The frequency of the subsidiary
radiation was $\sim 14,000$ mc/s. In the resonator used the high fre-
quency magnetic field of the signal was perpendicular to the ex-
ternal magnetic field and to the trigonal axis of the crystal.
Amplification and generation was observed at $2^{\circ}K$. The magnitude of
the constant magnetic field was about 380 oersted. The small value
of the gain-band width product in this case was mainly due to the
fact that the sample of the corundum in hand had too small a num-
ber of iron ions. It could be inferred from these preliminary ex-
periments that, as it seems, corundum with Fe^{3+} is a material sui-
table for making a paramagnetic amplifier in the decimetric fre-
quency band. There are 2 references: 1 Soviet-bloc and 1 non-Soviet

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A 10 cm frequency band ...

S/109/61/006/005/025/027
D201/D303

bloc. The reference to the English-language publication reads as
follows: J.E. King, R.W. Terhune, J. Appl. Physics, 1959, 30, 1844.
[Abstractor's note: This is essentially a complete translation].

SUBMITTED: September 26, 1960

Card 3/3

S/056/61/040/001/008/037
B102/B204

AUTHORS: Pashinin, P. P., Prokhorov, A. M.

TITLE: Measurement of the spin-lattice relaxation time in compounds
               with strong covalent bonds

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 40,
               no. 1, 1961, 49-51

TEXT: In connection with the fact that experimental studies of spin-lattice
relaxation had led to the finding of anomalies which could not be theoreti-
cally explained, the authors of the present paper recently studied the spin-
lattice relaxation on a simple system with two levels without hyperfine
structure. As such a system, the Fe^{3+} ions in the compound $K_3Fe(CN)_6$ with
strong dilution by Co^{3+} ions was selected. Because of the strong covalent
bond, the Fe^{3+} ion has the effective spin $S = 1/2$. Crystals with concentra-
tion ratios Fe:Co = 1:1000 and 2.1:1000 were studied. The spectrum of this
compound has already been previously studied (Ref. 6) at $20^{\circ}K$, and it was
found that two magnetically non-equivalent Fe^{3+} ions exist. The spin-lattice

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